

Lessons Learned about Mixed Methods Research Strategies in Systems Engineering: Evidence from PhD Dissertations

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Takeaway

Systems engineering researchers should give more attention to **methods** and **methodology**...

...both when **planning** their research and when **presenting** their findings.

Outline

Which methods do Systems Engineering researchers choose?

Data from PhD dissertations

Positivist vs. Interpretivist Research

Examples from recent research

Observations for New Students

Student Perspective

Methods

“a defined process for the acquisition and analysis of data” (Brown 2009)

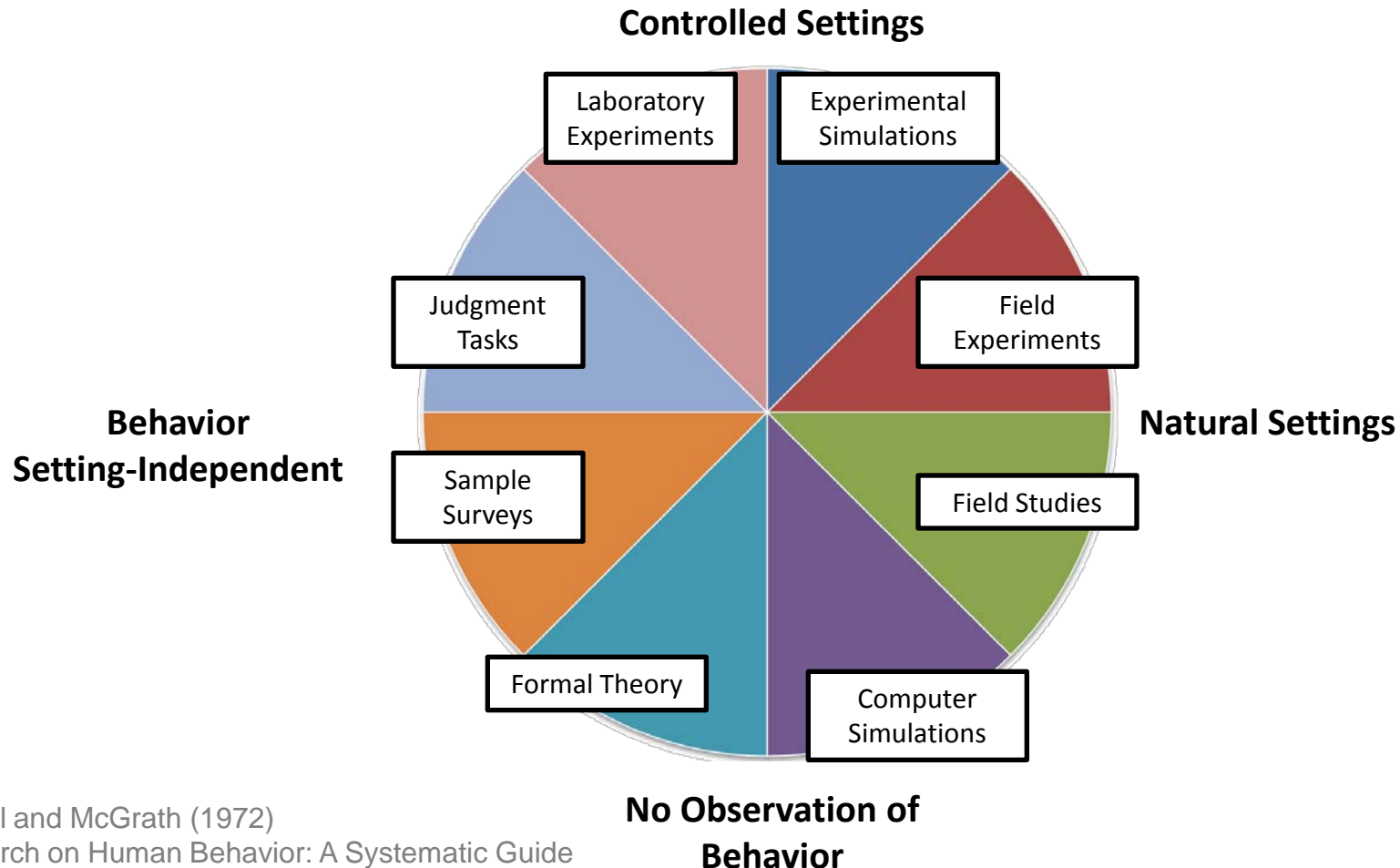
Methodology

“overarching standpoint from which to view the problem and potential routes to a solution”
(Brown 2009)



Which methods should you pick?

Literature – Research Methods



Runkel and McGrath (1972)
Research on Human Behavior: A Systematic Guide

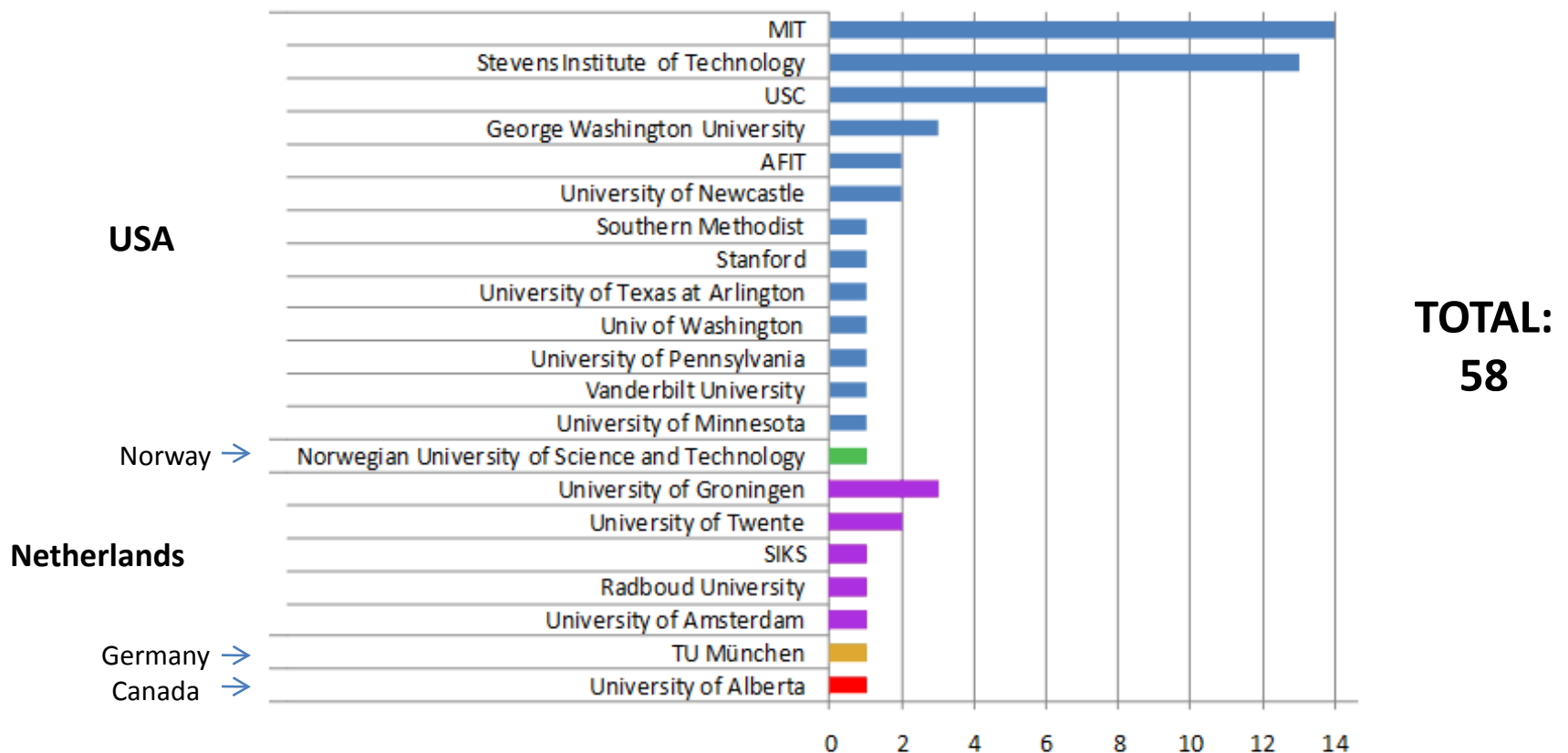
Data – Goals and Methods

Do current Systems Engineering researchers apply mixed methods?

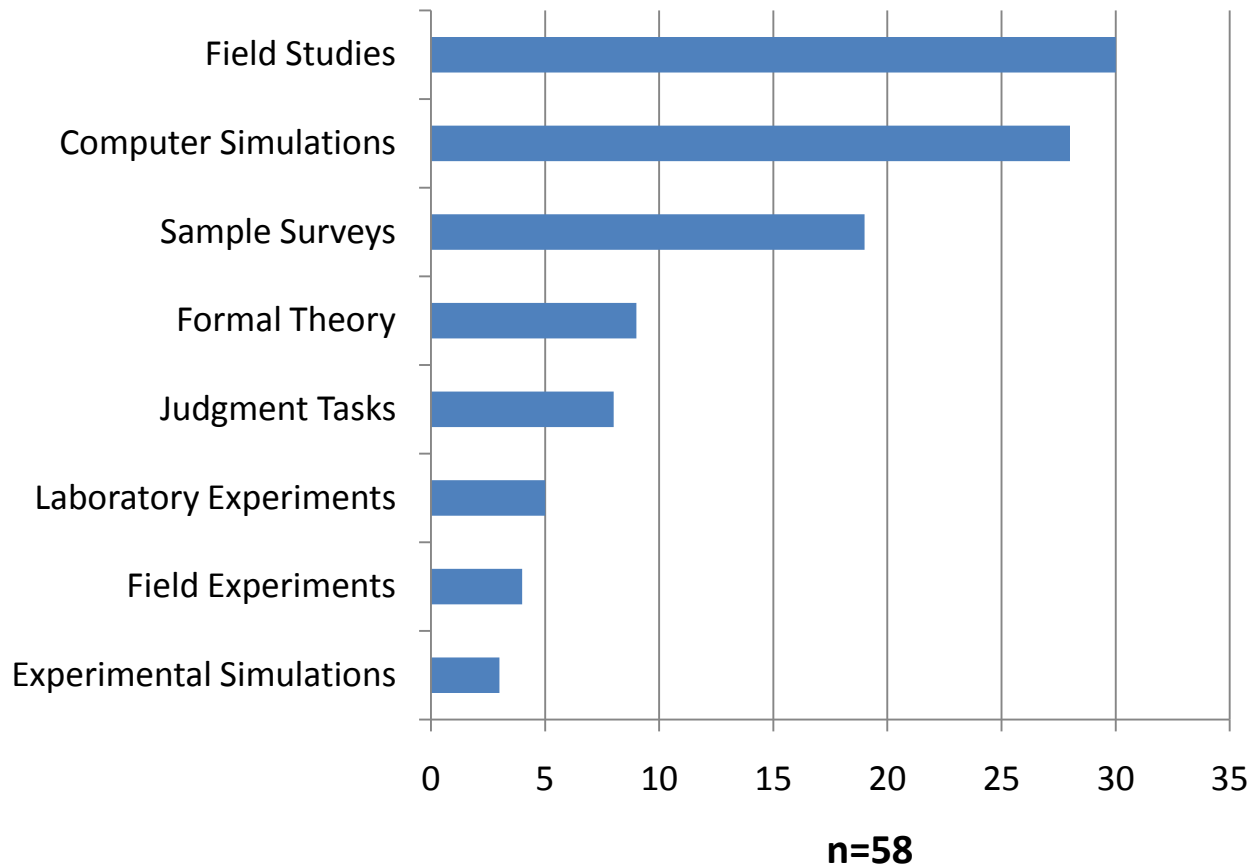
Which methods do Systems Engineering researchers choose?

Data – PhD Dissertations

Academic Institutions Represented

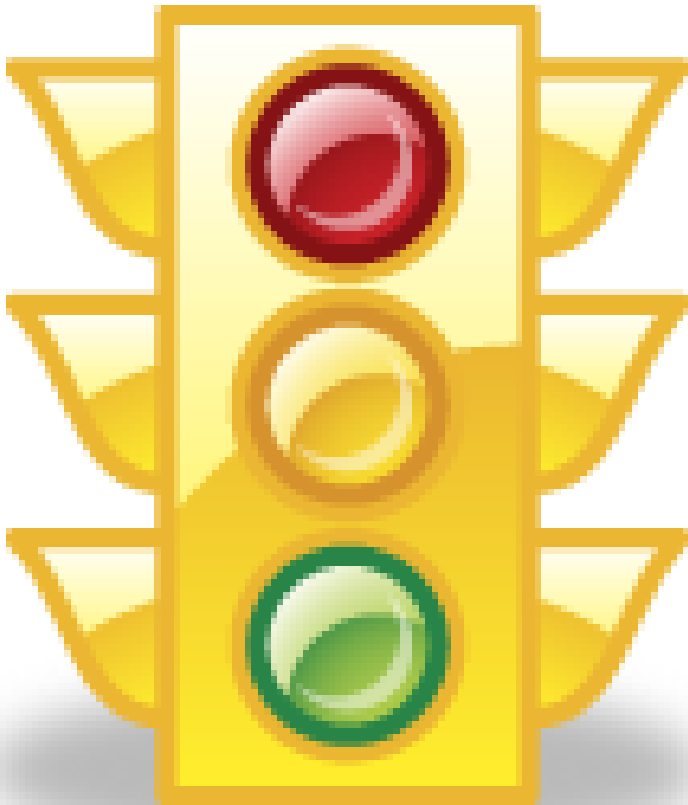


Data – PhD Dissertations



**62% of students
applied mixed
methods**

Discussion – Methodology

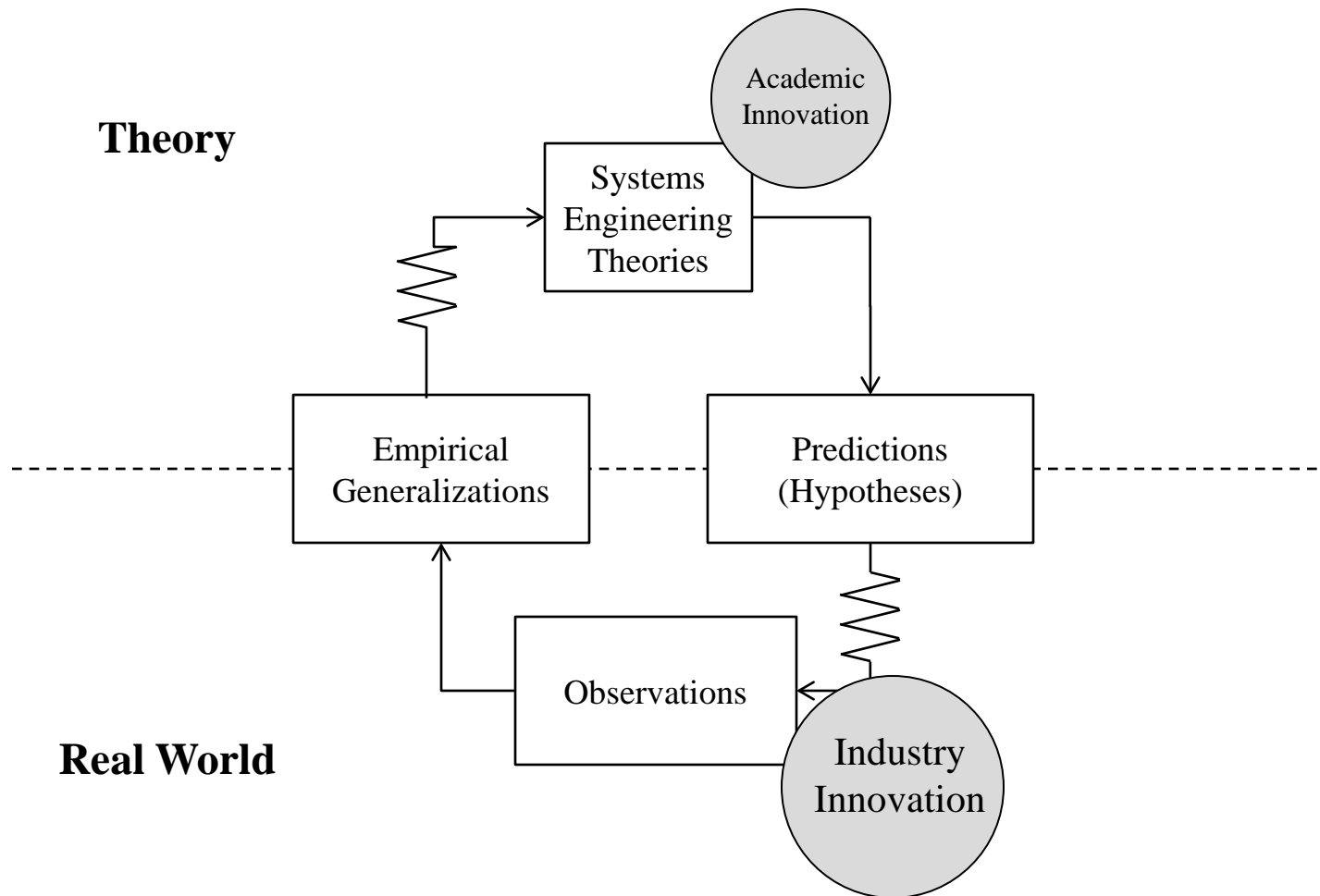


- 10 theses (17.2%) lacked clear logic explaining the research approach.
- 22 theses (38%) showed a logical process linking different methods together, but lacked a cohesive argument for how data were linked to research questions
- 26 theses (45%) documented a clear top-level architecture

n=58



SE and Industry



Discussion – Interpretivist vs. Positivist Research

Positivist

Construct Validity

Ask the right question

Interpretivist

Credibility

Does the participant buy it?

*Adapted from Klein and Myers 1999 and
Guba and Lincoln 1994*

Discussion – Interpretivist vs. Positivist Research

Positivist

Construct Validity

Ask the right question

Internal validity

Cause and effect

Interpretivist

Credibility

Does the participant buy it?

Confirmability

Do others agree?

*Adapted from Klein and Myers 1999 and
Guba and Lincoln 1994*

Discussion – Interpretivist vs. Positivist Research

Positivist

Construct Validity

Ask the right question

Internal validity

Cause and effect

External validity

Conclusions apply elsewhere

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Do others agree?

Transferability

Conclusions useful elsewhere

*Adapted from Klein and Myers 1999 and
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Discussion – Interpretivist vs. Positivist Research

Positivist

Construct Validity

Ask the right question

Internal validity

Cause and effect

External validity

Conclusions apply elsewhere

Reliability

Repeatable

Interpretivist

Credibility

Does the participant buy it?

Confirmability

Do others agree?

Transferability

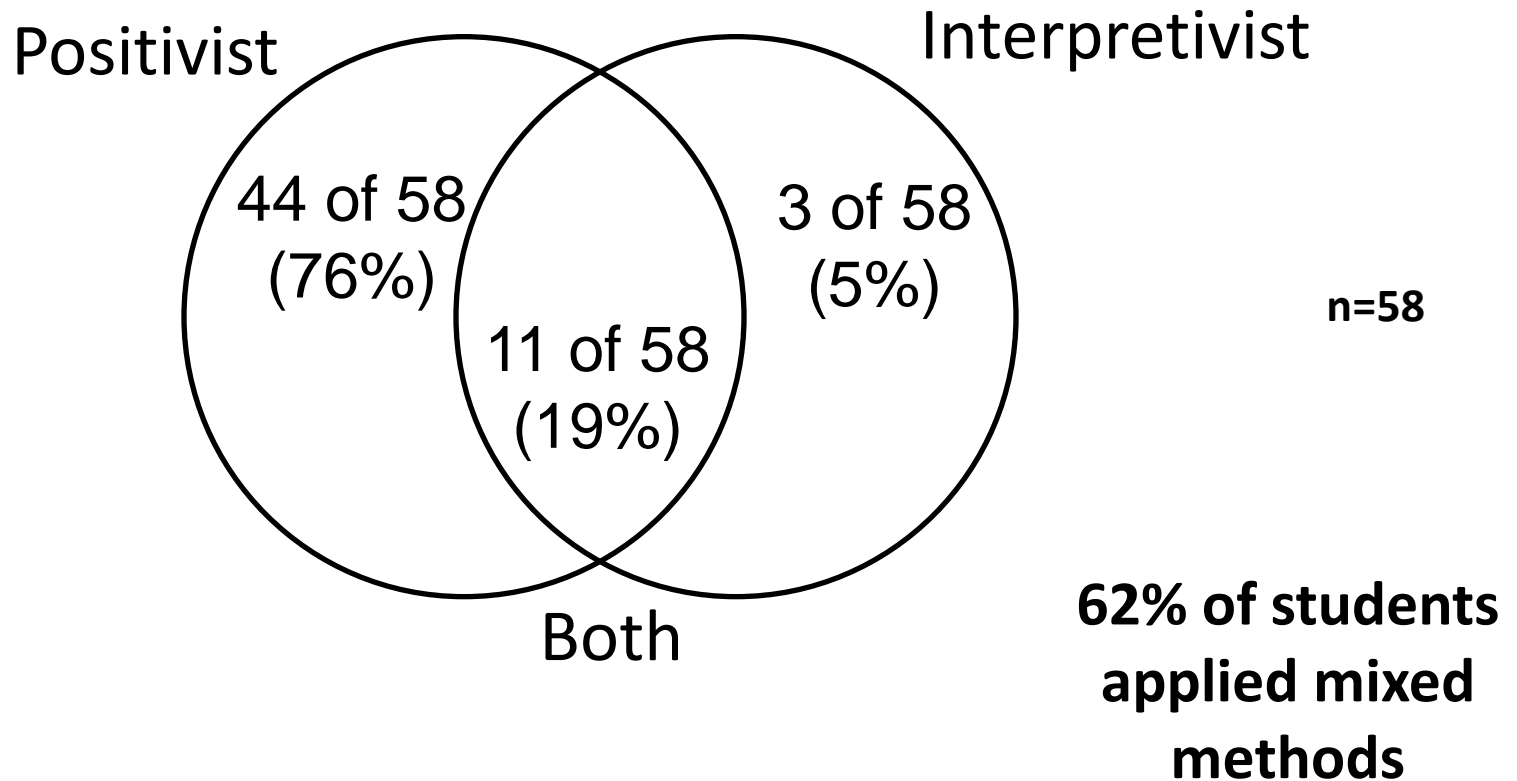
Conclusions useful elsewhere

Dependability

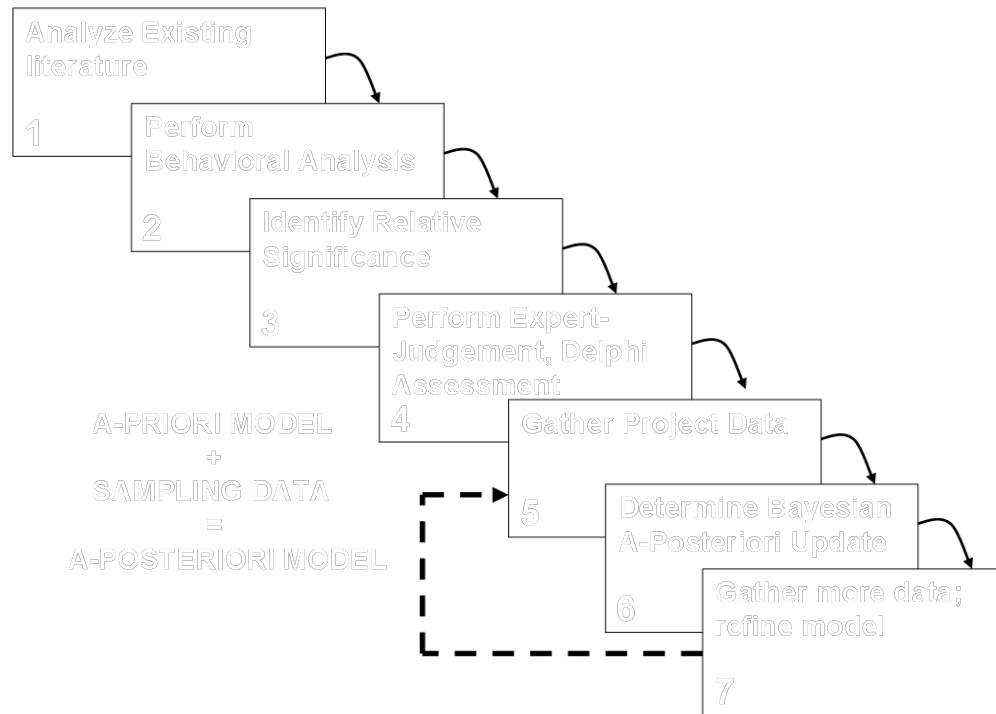
Repeatable under change

*Adapted from Klein and Myers 1999 and
Guba and Lincoln 1994*

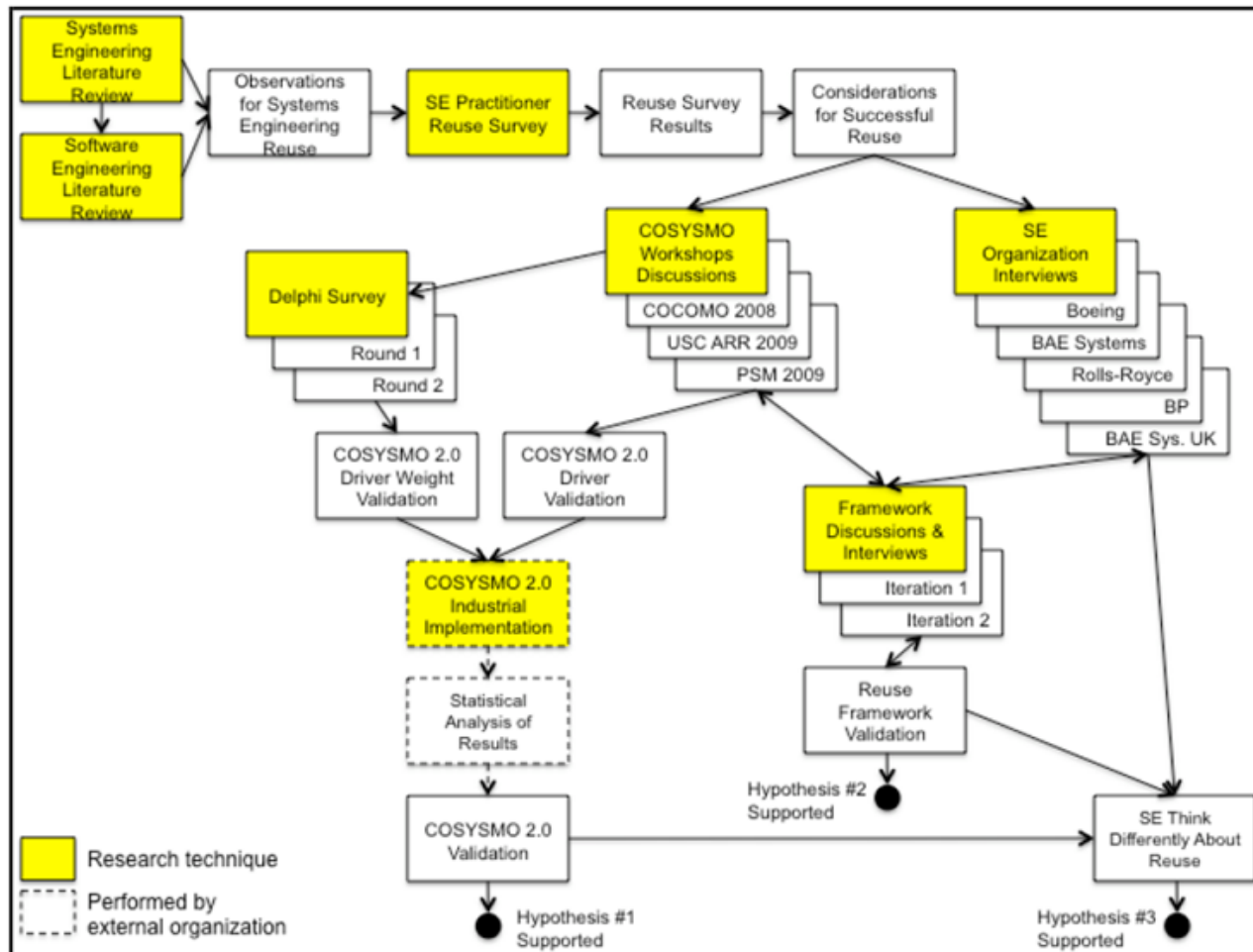
Discussion – Interpretivist vs. Positivist Research



Experiences



Experiences



Observations for New Students

Recommendation #1

Part of the topic identification process should include the consideration of possible research methods and methodologies that would be relevant to research goals.

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Recommendation #2

The topic of choice should address the needs of practitioners, and be achievable given the associated personnel, data, and time constraints.

Observations for New Students

Recommendation #1

Part of the topic identification process should include the consideration of possible research techniques that would be relevant to research goals.

Recommendation #2

The topic of choice should address the needs of practitioners, and be achievable given the associated personnel, data, and time constraints.

Recommendation #3

There should be sufficient flexibility in the definition of hypotheses to allow for changes given data availability, fidelity and quality.

Conclusion

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